THE SILENT "E"–ENVIRONMENT IN INTEGRATED SAFETY MANAGEMENT

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ABSTRACT
This paper describes the evolution of environmental management at federal facilities, from the past to the current state, using Los Alamos National Laboratory as a case study. The paper then discusses the opportunities and challenges facing us.

The predecessors to the Department of Energy (DOE)–the Atomic Energy Commission (1946-1975) and the Energy Research and Development Administration (1975-1977)–ensured civilian management and control of the nuclear weapons complex. The mission during this Cold War period was weapons research and production. Most work was done in an industrial setting within facilities; therefore, work was almost exclusively linked with human health and safety and facility capabilities. While health and safety were important considerations, environmental management (e.g., water, air, soil, biota) received limited review and typically only as related to human health and safety or mission work requirements. This early focus was based on ensuring national security, the professional backgrounds and training of the work force, and the limited understanding and regulations related to the environment.

Since the formation of DOE in 1977, the agency mission broadened in response to changes in the national security and energy supply issues, public interest in environmental protection, the expanded background of the workforce to include environmental professionals, and increased understanding and regulations related to environmental impacts. Environmental management evolved to primarily focus on compliance and day-to-day management.

The current Los Alamos mission includes secure energy supplies, energy efficiency, national security, science and technology, and environmental quality. This multi-faceted mission requires a broader and longer-term view of how to manage environmental resources within the framework of Integrated Safety Management. We are in the process of revising how we approach and implement environmental management. The potential application of ecosystem-based resource management, application of ISO 14001 standards (Environmental Management Systems), and broader use of life cycle planning and management (including waste minimization and pollution prevention efforts), offer opportunities for sustainable mission work and improved resource stewardship.

The Silent E–The Dilemma

In 1996, Los Alamos National Laboratory instituted a system of Integrated Safety Management (ISM) as an approach for bringing personal responsibility to operating its industrial facilities safely. The meaning of the term ìsafetyî was first thought to be obvious. Almost as an afterthought, however, the Laboratory added the tag phrase ìand environmentî to the definition of safety. Environmental professionals were perplexed. What did this mean? Was the protection of the environment seen only as an adjunct to worker safety instead of a goal in its own right? Was this an oversight on the part of the framers of the new policy, or evidence of a fundamental philosophy that environmental protection was merely a subset of the need to protect human health? As implementation of the new safety management system unfolded, while explicit on the meaning and implications of safety management, the guidance was essentially silent on how ISM would be used to protect the environment. How could the Laboratory fulfill its obligation for environmental protection?

Introduction

Los Alamos National Laboratory is one of a dozen or so national science labs operated under contract for the U.S. Department of Energy (DOE). The University of California (UC) is the management and operating contractor for three DOE labs, including Los Alamos National Laboratory. Los Alamos is part of the nuclear weapons complex, now operated by DOEís sub-agency, the National Nuclear Security Administration (NNSA). As such, the Los Alamos mission is focused on nuclear science and technology: to ensure the safety and reliability of the nationsí nuclear deterrent, to reduce the global threat, and to solve national problems in energy, environment, infrastructure, and health security.

Los Alamos National Laboratory is located in northern New Mexico at the base of the Jemez Mountains, a few dozen miles from Santa Fe. The lab was formed as a secret place in 1943 during the war years, carved from a combination of an exclusive private boys school, Hispanic homesteads, federal forestland, and traditional lands of nearby American Indian Pueblos. It was at Los Alamos that scientists first unlocked the secrets of nuclear energy and designed and built the first nuclear weapons of the nationís new arsenal.

Over the fifty-plus years of its existence the Laboratory has had to invent and develop techniques to do its unique work, including how to manage nuclear materials, work high explosives, and use other exotic materials. In so doing the Lab has had to determine how to protect the health and safety of the workers employed in its science labs and industrial facilities, and how to dispose of the waste products from these operations. Because very little was known about ìthings nuclear,î especially in the Labís early years, the risks of working with special nuclear materials and hazardous chemicals were not recognized or not well understood. The scientists in charge of developing the new materials and processes were for the most part used to working in a pre-war University experimental setting, not the industrial operations of a factory or production plant. Physicists and

mathematicians, they were more concerned about the fundamental properties of matter rather than the ìsoft sciencesî of the natural world.

The fledgling Laboratory brought in engineers and technicians tasked designing and manufacturing one-of-a-kind items for secret projects. So, the theoretical science laboratory became part factory, subject to the industrial standards of the day. In some cases these standards were ill-suited to the new radioactive materials needed for the Lab projects and so new techniques and processes evolved. Besides being unaware of the special properties of nuclear materials, the industrial climate of the 1940ís and 50ís in general was not attentive to human health hazards from industrial chemicals. The nation was focused on winning a war, getting product out the door, getting things done expediently, but had minimal focus on worker safety. With time, however, across the nation people began to become aware of the hazards of industrial operations on human health and began to insist on legislation to protect facility workers and the public at large. As a result the Laboratory began to hire health and safety personnel to work alongside the physicists and engineers.

Environment, Safety, and Society

Todayís industrial safety climate can be traced back before the passage of the Occupational Safety and Health Act of 1970 to early studies of toxicology and risk of industrial pollutants to human health. The first national interest in the environment was the potential for environmental media–air, water, soils, and biota–to be pathways that might introduce toxins or other threats to human health. For example, it was found that exposure to certain chemicals could cause specific illnesses or birth defects. Therefore, to reduce the threat to human health, an effort was made to reduce the number and amount of pollutants that might reach the public through the air or from drinking-water supplies. In the 1960ís, then, the precursors of todayís environmental laws emphasized the protection of human health by controlling hazardous emissions to environmental pathways such as air and water.

In 1970 the nation first established an environmental policy that stated that we would protect the environment for its own sake, beyond merely considering the environment as a pathway for impacts to human health. The National Environmental Policy Act (NEPA) stated that in addition to protecting human health and welfare it is the policy of this country to "prevent or eliminate damage to the environment and biosphere." Subsequent environmental laws, such as the Clean Water Act and the Resource Conservation and Recovery Act, built on the new national policy and included specific provisions to protect the environment in addition to protecting human health. Other new environmental laws, such as the Endangered Species Act, were enacted specifically to protect defined facets of the environment that did not particularly relate to human health. The environmental laws of the 1970's and 80's began to impose requirements to protect the environment from harmful impacts in addition to the consideration of protecting specific aspects of the environment as a way to manage or minimize harmful impacts to human health.

Federal agencies with a traditional mission of land management, such as the bureaus of

the Department of Interior, were quick to realize that the new environmental laws were a central component of their mission. Other agencies, however, resisted. After the passage of NEPA in 1970, for example, the Atomic Energy Commission (DOE's predecessor) decided that the new law did not apply to its actions because of its national security mission. Only after several bouts of litigation and legal opinions did the DOE in the early 1990's issue Secretarial guidance and agency regulations affirming that national policies of protecting the environment were part of the DOE mission. Site managers continued to be reluctant managers of environmental resources, however; for example at Los Alamos, it was not until the 1995 injunction and litigation regarding constructing a major new weapons facility that site managers began to understand the importance of the environmental laws and their relevance to site mission. Since the 1980's, the Laboratory has followed the lead of other DOE sites and has slowly built up a cadre of environmental professionals to carry out its environmental compliance work. Within the past ten years the site managers have begun to recognize that the Laboratory is operated within a larger regional environment that must be considered.

Figure 1 shows the relationship of site operations to the environment in the past and now. In the past, the environment was seen merely as a pathway that might affect human receptors, including workers at the site as well as the general public. Now, however, the environment is seen as a receptor of impacts alongside the human receptors. Site operations can cause an impact on these environmental receptors. In addition, the specifics of the site's environment, such as geologic faults or wildlife, can impact how the site carries out its operations; facilities may require additional structural bracing to withstand geologic events, or transportation corridors modified to minimize animal-vehicle collisions. Now, stewardship of the siteís environment is likely to be considered and managed within a regional context.

Integrated Safety Management (ISM)

At Los Alamos, besides overlooking environmental laws, a laissez-faire attitude towards safety had built up over the decades. This changed abruptly in the mid-1990s. In rapid succession the Laboratory was faced with its first operational fatality in years (a guard shot during a routine training exercise), followed by a worker put into a coma as a result of an electrical accident, then a worker severely injured in a forklift accident. After a "lessons learned" study indicated that the prevailing attitude of Laboratory workers was that safety was "someone else's responsibility," the Lab developed a new process that put the responsibility for personal safety squarely on the shoulders of the individual. Dubbed "Integrated Safety Management," or ISM, the new process rolled out in November 1996 represented a new commitment by the Laboratory to integrate personnel safety with the management of its work.

The new ISM process clearly established institutional expectations that safety was everyoneís responsibility and established a flow of work control from the highest levels of management, through the line managers, to the individual worker. The analysis of work and establishment of safety controls was institutionalized into a five-step process that Laboratory worker now know well: 1) define the work; 2) analyze the hazards; 3)

develop controls; 4) perform the work; and 5) ensure performance. See Figure 2. Through a feedback mechanism, the cycle goes back to step one and repeats. Instead of the one-size-fits-all approach used in the past, the Laboratory established a nested, or graded, approach moving from a broad institutional scope of work, to the scope of work performed at a specific facility, to the narrower scope of a specific activity performed at that facility.

But how did ISM come to include a concern for environmental protection? At about the same time that the ISM document was being drafted in 1996, in a separate effort the Laboratory began to look at specific situations where environmental considerations might be at issue. Some Lab environmental professionals felt that a separate, parallel approach might be used to address environmental concerns: "Integrated Environmental Management." However Laboratory managers did not want to be inundated with separate-but-equal management systems. A last minute addition to the final ISM draft fixed the problem, as "safety" was footnoted "to be synonymous with environment, safety and health (ES&H) and used broadly in reference to protection of the worker, the public, the environment, and property." (ISM, 1996, p. 4.) This wording change represented a concession to environmental considerations, although it reflected the Lab's traditional view of environment as a pathway for impact to human receptors and the Lab's emphasis on regulatory compliance rather than environmental stewardship.

However, it was a first step, and in 1999 the Laboratory Director included environmental protection alongside safety as one of his management goals: "We are committed to achieving excellence in environment, safety, health, and security performance. In order to meet the moral imperative not to injure people, [and] the environment, while accomplishing our mission, and the business imperative to meet the environment, safety, health, and security requirements of the [UC] contract [we] will strive to have ZERO environmental incidents" (ISMDD, 2000, p. xi). The problem was how to implement this new goal.

Mission vs. Management–the Cost of Environmental Management

Too often we hear a project manager say that it is "too expensive" to address environmental concerns–that environmental analysis or environmental mitigation will "delay" a project or that it is "an unfunded mandate." "Every dollar spent on spotted owls is a dollar not spent on mission," we hear. "Environmental protection is not part of our mission–this is not a national park."

We beg to differ. Los Alamos National Laboratory is operated on federal land, and funded with federal (tax) dollars. Therefore the activities at the Laboratory site are clearly subject to federal environmental laws. In addition there is another compelling reason to comply with environmental management mandates–the operation of the Laboratory, and accomplishment of mission, is ultimately dependent upon responsible management of the siteís land base. It is unlikely that the nation will invest in moving the mission of Los Alamos to another site at any time in the foreseeable future due to the magnitude of the costs associated with replicating its unique capabilities and facilities.

So, it is reasonable to assume that the Laboratory will continue to be operated at this location for several more decades.

The Laboratory is proud of its mission responsibilities assigned by Congress and the President. However, in order to accomplish the mission set, certain things must be in place (Figure 3). To accomplish the mission, certain work products must be produced. These may be tangible, such as the nuclear weapons parts manufactured at Los Alamos. They may be intangible, such as the intellectual properties of weapons physics or means to accomplish threat reduction or the science of energy development. In either case, certain operations must take place, such as manufacturing objects or computer modeling. These are the work of people–the workers. The people work in buildings (facilities). The facilities are tied together by various types of infrastructure, including roads, security systems, electrical utilities, sewers, and fiber optic cables. However, all of these rest on the land base–the 43 sq. mi. of forested, rocky, largely undeveloped land that makes up the site (less than 5% of the land at Los Alamos is used by the 2,000 Lab facilities).

The dependence of Lab mission on its facilities and land became very clear to everyone in May 2000. In just a few days, a huge wildfire, the Cerro Grande Fire, burned an area of over 75 sq. mi. including about 25% of the Los Alamos National Laboratory site. Although few Lab facilities burned, the site was closed for almost three weeks. The disruption to the operation of the Lab affected its ability to meet its mission mandates, and cost hundreds of millions of dollars to recover lost work. For the first time the Laboratory personnel could see that the siteís environment had a direct impact on its ability to conduct mission, and that operational neglect of the forest had resulted in direct financial impact to mission. This was not a matter of Lab operations affecting obscure pathways to human health. This was an overwhelming event that dramatically underscored the environmental consequences of choosing to site and operate a nuclear weapons laboratory in the middle of a forest.

Following the fire, the Laboratory and its parent agency, NNSA, recognized the compelling need to begin to actively manage the natural resources of the Lab's environment–namely, the trees. In the two years since Cerro Grande, the Lab has spent millions of dollars to thin thousands of acres of forest in an effort to reduce the hazard of future wildfires. In order to thin the trees the site had to consider impacts to wildlife and the numerous archaeological sites of the area. This is the first instance of a comprehensive, integrated approach to managing the siteís environment in the fifty-plus years since the Laboratory came into being. Figure 3 shows that Integrated Management reaches all the way from carrying out mission requirements to managing the land base.

Current and Future Approach to Environmental Management

The Laboratory continues to improve its environmental management system. Executive Order 13148, "Greening the Government Through Leadership in Environmental Management," states "each Federal agency is responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision-making and long-term planning processes, across all agency missions, activities,

and functions. Consequently, environmental management considerations must be a fundamental and integral component of Federal Government policies, operations, planning and management." DOE Notice 450.4, which implements EO 13148, establishes goals and objectives including achieving specific pollution prevention goals, continued environmental improvements and energy efficiency goals. The Laboratory is committed to meeting its environmental stewardship responsibilities as outlined in EO 13148 and other drivers. These responsibilities can be integrated with mission activities in a cost-effective manner.

To improve the environmental component of ISM system, the Laboratory initiated multiple actions. These actions were predicated on several assumptions and operational imperatives, which included:

- Sustainability and stewardship is an obligation and should be part of the ISM system.
- Natural resources are as essential to mission as facilities and infrastructure.
- Environment is already part of the ISM system but it is poorly implemented (silent).
- No separate systems are needed; we will build on existing systems and processes to support Integrated Management and line ownership.
- We need to improve consistency (one lab–one voice) while maintaining flexibility for programs and facilities.

Review of the Laboratory ISM System and ISO 14001

We first compared the Laboratory ISM system versus the ISO 14001 standard. We wanted to confirm if our assumptions related to the ISM system were supported and we wanted to identify strengths and weaknesses of our current ISM system.

We confirmed that environmental considerations are part of ISM system and that all ISO 14001 elements were part of the existing system. Environment is addressed as part of the system in the ISM Description Document(ISMDD), LA-UR-98-2837, the controlling ISM document for the Laboratory. Specific environmental requirements that are part of the contract between the site operator, UC, and NNSA are identified in the Laboratory Performance Requirement document (LPR-404-00-00.0). The requirements (including roles and responsibilities) for air quality, water quality, natural and cultural resources, NEPA, and waste management are further specified in a sequence of Laboratory Implementing Requirement (LIRs) documents which focus on regulatory compliance. These environmental LIRs focus on the activity level and environmental protection actions are integrated through the "safe work practice" process and documented in a Hazard Control Plan for the activity. The "safe work practice" process is further supported for environmental considerations through the ESH-ID, excavation permit, and NEPA, cultural resources, and biological resources (NCB) review processes.

One weakness of environmental management in the existing ISM system is the lack of a parallel process and documentation structure at the institutional level similar to the facility and activity level process and structure. The Laboratory's expectations and goals were not clearly interpreted for environmental management (e.g., "zero environmental incidents" was not further defined beyond the ISMDD). This resulted in a poorly defined

institutional level environmental management system intended to ensure that the environment can sustain long-term and cumulative activities. Goals, objectives, and performance indicators for environmental aspects were vague, not defined, and not easily accessible by senior or line managers. The system and processes used to manage and direct the environmental stewardship did not effectively address the full breadth of natural resource issues. In addition, there was no consistent system to evaluate positive and negative results to specific resources (e.g., no trade-off review). Similarly, there was poor linkage between Laboratory-wide environmental planning and actions, and activity- and facility-level planning and actions.

During the first several years of ISM implementation, the Laboratory focused on the processes and documents. The Laboratory is now working to improve its overall ISM system performance by focusing on attitudes, behaviors, and actions. Based on the comparison between the Laboratory ISM system and ISO 14001, the actions to improve the environmental component need to focus first on the processes with the intent to support the overall ISM system effort of improving attitudes, behaviors, and actions.

Integrated Natural and Cultural Resource Management Plan (IRMP)

One of the key process improvements the Laboratory and DOE/NNSA have initiated is the development of an Integrated Natural and Cultural Resource Management Plan (IRMP) and implementation approach. DOE/NNSA has drafted the IRMP, which establishes principles and expectations consistent with the NNSA mission.

DOE/NNSA's underlying principles for the IRMP are:
- Develop and operate Laboratory facilities consistent with mission assignments, sound ecological principles and regulatory compliance.
- Restore and maintain ecosystem viability while accomplishing mission assignments and operations.

DOE/NNSA's expectation is that the management of natural and cultural resources will be based on the principles of ecosystem management and sustainable development. DOE/NNSA further expects that natural and cultural resource management will be integrated into the overall management of the Laboratory. The IRMP will serve as an essential component of the environmental management system (EMS) that will integrate natural and cultural resource stewardship and compliance accountability into daily decision-making and long-term planning processes, for all programs, facilities, projects, activities, and functions.

The IRMP also establishes some broad interim goals until the Laboratory's implementation approach is finalized. NNSA goals for the Laboratory are to continue to improve performance in the areas of water conservation, electrical consumption, waste management and wildfire hazard reduction.

The Laboratory's IRMP implementation approach builds on existing and on-going efforts. The focus of the approach is to strengthen the stewardship components of the

environmental component of ISM. The goal of the Laboratoryís IRMP implementation is to develop solutions that advance both mission and environmental stewardship in a cost-effective manner while minimizing conflicts.

The Laboratory has been developing separate resource management plans for several years and is now expediting their development to strengthen the environmental component of the ISM system. These plans include:

- Air Resources Quality Management Plan
- Groundwater Protection Management Program– Hydrogeologic Work Plan
- Watershed Management Plan
- Biological Resources Management Plan
- Cultural Resources Management Plan
- Waste Minimization and Pollution Prevention Plan

Some of these plans will be composed of subplans and/or address multiple resources. As an example, the Biological Resources Management Plan will be composed of a several subplans including a Wildfire Hazard Reduction Plan and a Threatened and Endangered Species Habitat Management Plan. It will also address several other resource components including wetlands, wildlife management, and ecological risk management. Many of the resource plans overlap in the geographic area and in resources that are addressed.

These documents are being prepared by the subject matter experts in the organizations responsible for providing institutional expertise for resource management. They have been excellent vehicles for the experts to establish a regulatory- and science-based position for resource management. However, none of these plans are linked with the current ISM system of documents or processes. Therefore, they have limited or inconsistent use by line managers responsible for specific activities or facilities. Similarly, Laboratory management does not have a process in place to review and balance the goals and actions identified in these separate plans. Therefore, it is difficult to consistently establish institutional goals, work priorities, and funding levels.

The Laboratory's IRMP implementation process will be to consolidate the goals, objectives, and performance indicators from each of the natural resource plans into a reporting document for senior management approval and support. This document will be the institutional equivalent to activity-level Hazard Control Plans to define environmental issues and the actions to minimize environmental impacts from mission work (Figure 4). The report can then be used as the technical basis for senior management to identify risk levels, prioritize actions, and establish funding levels across all resource areas using consistent criteria. Decisions related to goals, objectives, and annual tasks can be documented and implemented through the specific resource plans. In addition, environmental performance indicators developed and vetted institutionally can be communicated consistently to all line managers. The managers can incorporate and implement actions to address these performance indicators at the activity level. The implementation actions can be identified through ìsafe work practicesî process and documented in the Hazard Control Plans for activities and the Facility Work Control

Plans for facility-level work.

The IRMP approach also meets the needs of Integrated Management at the Laboratory. The IRMP documentation serves as the environmental support plan base for the mission. It is the functional equivalent to the Ten Year Comprehensive Site Plan and other key support documents that are essential for the consistent development of the Laboratory to meet mission requirements (Figure 5).

Other Environmental Management System Improvements

Three additional actions, one to fill a short-term need and two long-term action have been taken to further improve the environmental management at the Laboratory.

The immediate action taken while the IRMP is being developed is to identify short-term environmental goals and actions to meet those goals. We used a Delphi process to identify pressing environmental issues. The process re-affirmed that previously identified environmental issues remained as high priority. Issues were identified from existing issue and action lists including the Site-Wide Environmental Impact Statement (SWEIS) Mitigation Action Plan (MAP), wildfire hazard reduction actions, Clean Air Act compliance actions (e.g., ozone depleting substance phase-out). The issues list was vetted among an interdisciplinary team of managers and subject matter experts. Criteria were used to identify the importance to the Laboratory in terms of regulatory compliance, fulfillment of commitment, mission impact, cost, and likelihood of success. The final list was provided as a recommendation to Laboratory Senior Management for adoption and funding.

The first long-term action taken was to realign the organization so that all environmental organizations responsible for institutional environmental leadership and action are in one organization and separate from the health and safety organization. This reorganization simplifies the reporting and authority lines and elevates environmental considerations to an equal management level with health and safety.

The second long-term action that has been initiated is to further streamline the review and improvement the implementation of the ìsafe work practicesî process for activity- and facility-level work. This streamlining focuses on integrating the ESH-ID reviews, excavation permit, and NCB review processes in support of preparation of Hazard Control Plans and Facility Work Control Plans.

Summary of Benefits

The improvements of the environmental management component within the existing ISM system ensures support of the Laboratory's Integrated Management initiative, and will be more widely accepted by managers because it is within the ISM system. The result of the implementation of the improvements will improve compatibility of mission and environmental stewardship and enhance managementís understanding and implementation of their environmental stewardship and protection responsibilities. In

addition, it will support efforts to improve public trust in the management of the natural resource base, facilities and infrastructure, and mission activities.

Conclusion

Los Alamos National Laboratory initially developed its ISM system without consideration of environmental management concerns. Coming from an industrial hygiene perspective, the framers of the new policy saw the environmental media of the Laboratory site relevant only as pathways for possible impacts to human health, as witnessed by the Laboratoryís regulatory framework that focused only on these aspects of the environment. As an afterthought, the 1996 ISM document footnoted "safety" to also mean "environment."

At about the same time, environmental professionals started to think about the need to manage the natural and cultural resources of the Laboratory. Slowly a movement grew to develop a comprehensive, or integrated, system of management that would recognize the interrelationship of the need to operate the site to accomplish mission, and the need to manage the attributes of the ambient environment. This effort coalesced in the current IRMP. Under the IRMP, the same principles that underlie ISM–namely, management commitment and worker involvement, along with the management statement of ìzero environmental incidentsî ñ are used to drive home the message that protection of the environment is everybody's business. The Laboratory has begun to understand that it cannot operate its facilities and do its work without consideration of the land base and the environment.

Although the IRMP approach was not developed with the same rigor as other forms of EMS, such as ISO 14001, the end result is much the same. IRMP will provide a reasoned EMS that serves to protect the environment while enabling Lab mission. This represents a departure from past thinking, which considered the environment only as an adjunct to human health. As long as we look at "environment" only as a pathway for human health, as long as we look at ISM only as a means to manage human health, we fail. A system that does not address all aspects of the environment falls silent–"the silent E." Through a sound IRMP, however, we will be able to manage our site "in harmony" with the environment, as envisioned by the national environmental policy enacted so many years ago.

References

American National Standards Institute: International Organization for Standardization. International Standard ISO 14001, Environmental Management Systems ñ Specification with guidance for use. 1996.

Department of Energy, National Nuclear Security Administration. Integrated Cultural and Natural Resources Management Plan for Los Alamos National Laboratory. In press.

Department of Energy. 10 CFR 1021, National Environmental Policy Act; Implementing Procedures and Guidelines. 1992 as amended.

Department of Energy. DOE Notice 450.4, Assignment of Responsibilities for Executive Order 13148, Greening the Government Through Leadership in Environmental Management, February 5, 2001.

Department of Energy. Mitigation Action Plan for the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory. October 1999.

Department of Energy. Secretary of Energy Notice SEN-15-90, National Environmental Policy Act. February 5, 1990.

Department of Energy. Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, DOE/EIS-0238. January 1999.

Executive Order 13148, Greening the Government Through Leadership in Environmental Management. April 21, 2000.

Los Alamos National Laboratory. Integrated Safety Management. Approved by Sigfried S. Hecker, Director, November 1996.

Los Alamos National Laboratory. Laboratory Performance Requirement (LPR) 404-00-00.0, Environmental Protection, February 1998.

Los Alamos National Laboratory. Ten-Year Comprehensive Site Plan. LA-UR-01-1838. April 13, 2001.

Thullen, Philip, et al. Integrated Safety Management Description Document (LA-UR-98-2837). Approved by John C. Browne, Director, September 1999. Rev. 3.1, April 24, 2000.

Webb, M. Diana, and Kelly Carpenter. The Cerro Grande Fire, Los Alamos New Mexico, LA-UR-01-1630. In American Planning Association 2001 National Planning Conference Proceedings, March 2001.

Webb, M. Diana. DARHT–An "Adequate" EIS: A NEPA Case Study, LA-UR-97-1459. In Proceedings of the 22nd conference of the National Association of Environmental Professionals. 1997.

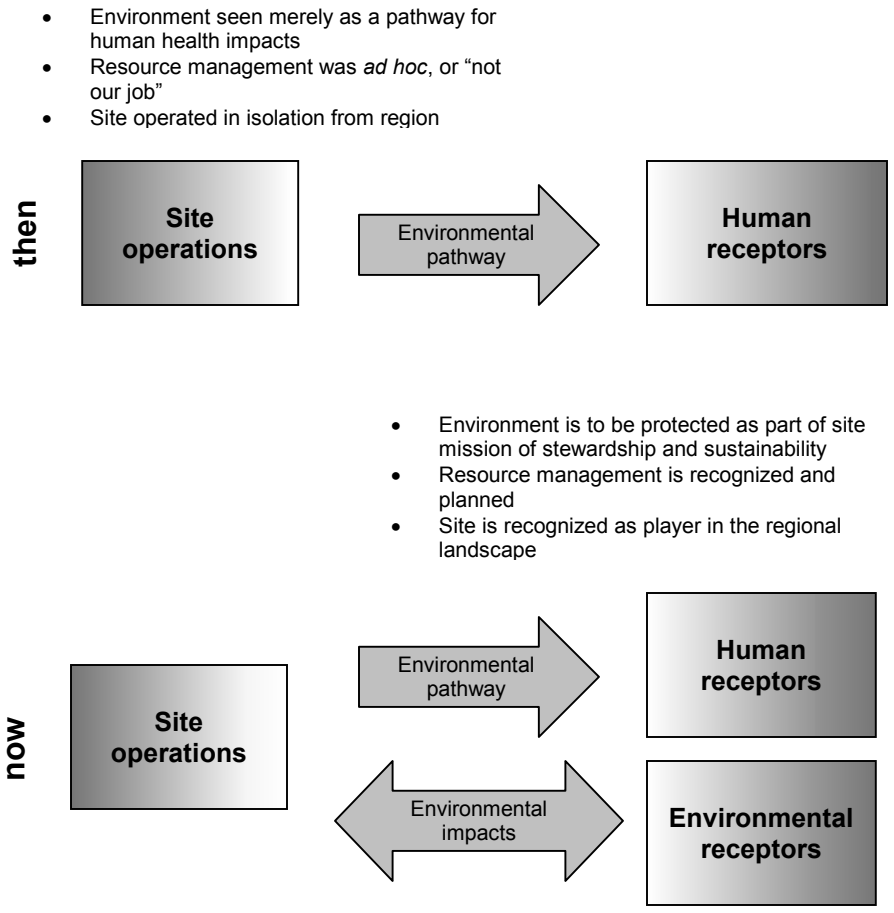

Figure 1. Consideration of the Environment, Then and Now

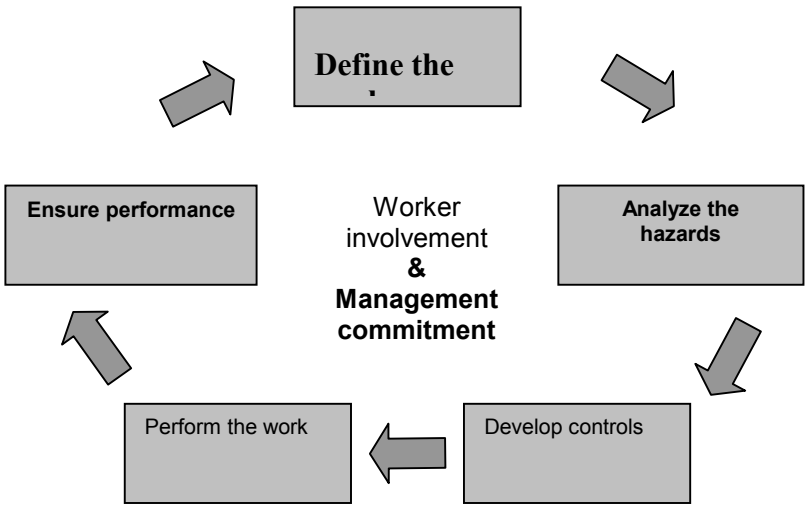

Figure 2. Integrated Safety Management – the Five-Step Process

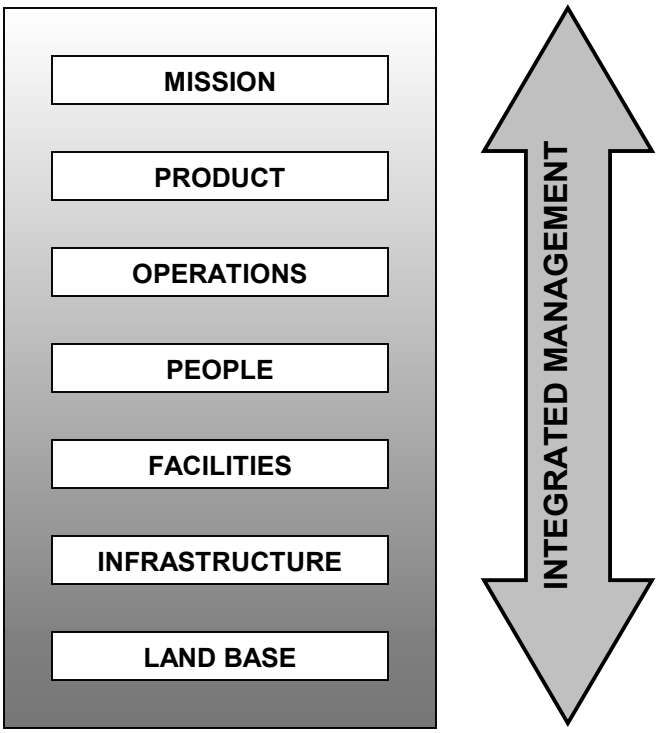

Figure 3. Integrated Management Spans all Aspects of Facility Management

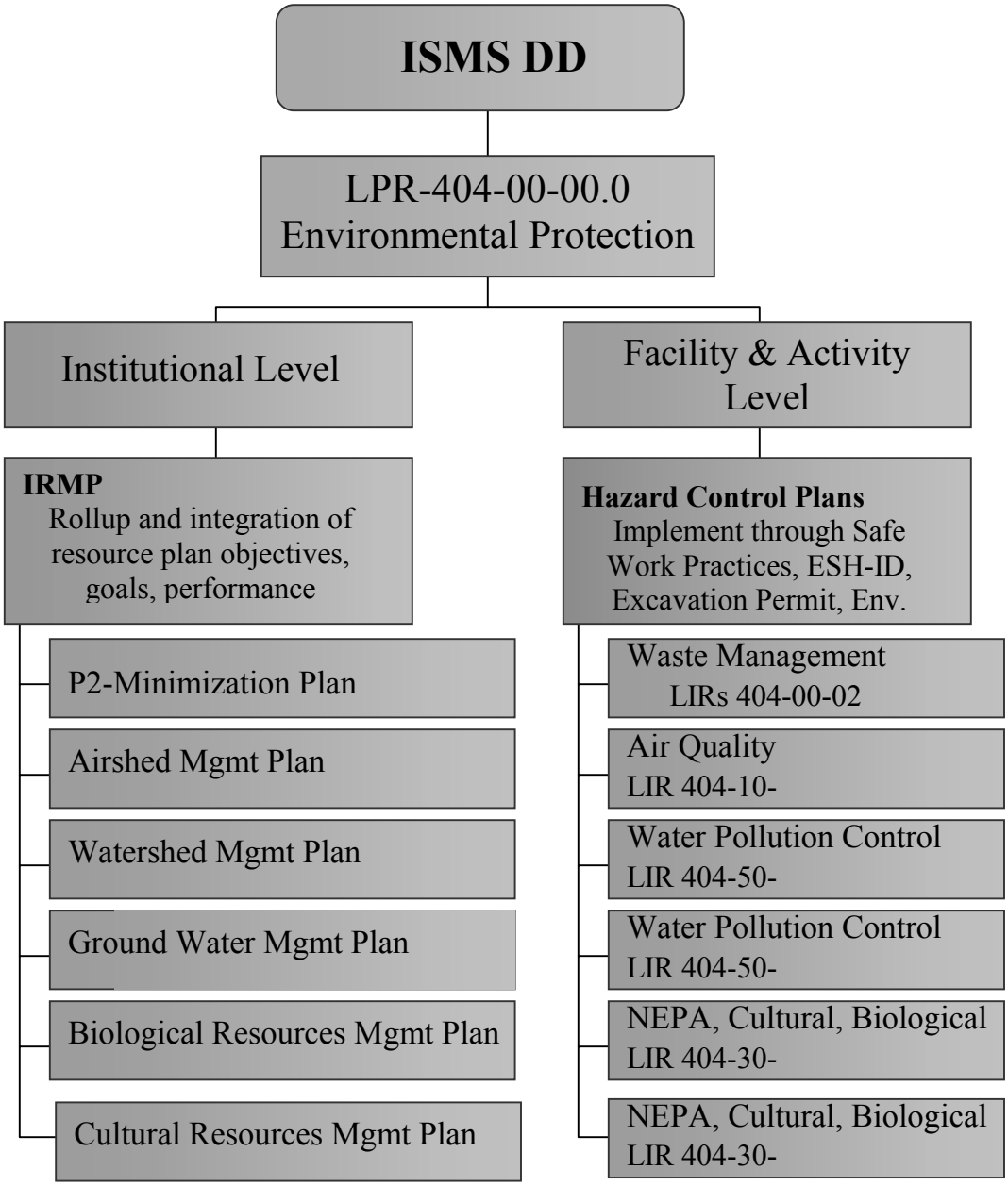

Figure 4. ISM Document Hierarchy for Environment

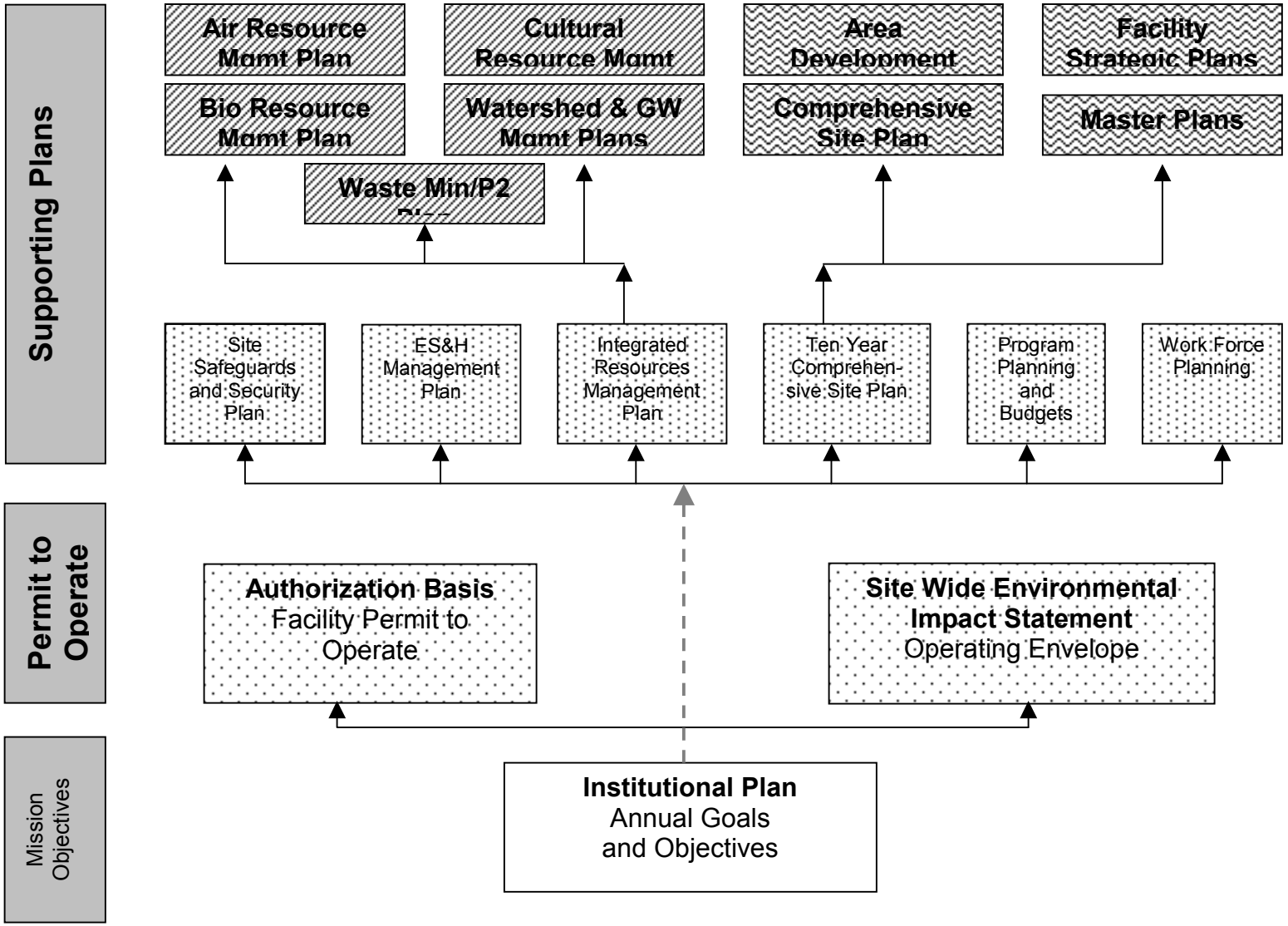

Figure 5. Laboratory Planning Document Hierarchy